P-54

Complexes based on trigemini surfactants and natural lipids as new effective carriers for gene therapy

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Gene therapy is a method which permits the repair of organism throughout the adjustment of genetic information. The underlying mechanism of gene therapy is transfection - the process of delivery of genetic material into cells. Carriers used in gene therapy should be effective, non-toxic, non-viral and as similar as possible to the cell membrane (biocompatible) [1].

One of the potential carriers for gene therapy are complexes based on surfactants and lipids [1, 2]. Natural lipids are biocompatible with body cells and non-toxic, as opposed to polycationic surfactants which are also biocompatible but often are toxic. In such complexes the presence of surfactant molecules is necessary due to their ability to bind nucleic acids [3, 4].

Our studies focus on trimeric surfactants. They are characterized by improved properties in comparison to dimeric or monomeric counterparts. This study was performed on mixed systems composed of two types of trigemini surfactant and mixtures of lipids (DMPC, DOPE, DPPC). Additionally, DNA varying in size were tested.

To obtain structural information about formed systems, small angle X-ray scattering measurements using synchrotron radiation were performed in DESY, at beam line P12 (EMBL Outstation Hamburg, Germany). The morphology of the complexes was also characterized by the use of Atomic Force Microscopy. To determine the thermodynamic parameters of the phase transitions in lipid containing systems, the infrared spectroscopy and differential scanning calorimetry were used. Additionally, to identify the conformational changes of DNA molecules upon the addition of surfactant, circular dichroism spectroscopy was used. The surfactants ability to bind nucleic acids was assessed by electrophoretic experiments.

Trigemini surfactants formed stable complexes with DNA at concentrations lower than working concentrations of gemini surfactants (they are more efficient). The addition of lipids also improved the efficiency of the complexation and thus led to the reduction of cytotoxicity.

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